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Accuracy and time efficiency of conventional and digital outlining of extensions of denture foundation on preliminary casts

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PURPOSE. The purpose of this diagnostic study was to assess the accuracy and time efficiency of a digital method to draw the denture foundation extension outline on preliminary casts compared with the conventional technique. **MATERIALS AND METHODS.** A total of 28 preliminary edentulous casts with no anatomical landmarks were digitized using a laboratory scanner. The outlining of the entire basal seat of the denture was performed on preliminary casts and digitized. Casts with no extension outline were digitized and outlines were drawn using software (DWOS, Straumann). The accuracy of the extension outlined between both techniques was evaluated in the software (GOM Inspect; GOM GmbH) by file superimposition. Specificity and sensitivity tests were applied to measure accuracy. The paired t-test (95% CI) was used to compare the mean total area and the working time. **RESULTS.** The accuracy ranged from 0.57 to 0.92. The buccal and labial frenulum showed a lower value in the maxilla (0.57); while the area between the retromolar pad and buccal frenulum (0.64) showed a lower score in the mandible. The maxillary denture foundation and the working time for both arches were significantly longer for the digital method ($P < .001$). **CONCLUSION.** The denture foundation extension outline exhibited a sufficiently excellent accuracy for the digital method, except for the maxillary anterior region. However, the digital method required a longer working time. [J Adv Prosthodont 2024;16:139-50]

KEYWORDS

Accuracy; Computer-aided design; Complete denture; Denture foundation; Edentulous mouth

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INTRODUCTION

Advancements in digital technology have the potential to optimize the working time and ensure the speedy delivery of complete dentures, improving the cost effectiveness of the treatments.[1-4] The digital workflow based on the computer-aided design and computer-aided manufacturing (CAD-CAM) system has played a role in the prosthodontics design defined by 3D parameters.[5] Although complete dentures may be manufactured using CAD-CAM systems, reducing or eliminating errors[6-9] is still a challenge in scanning edentulous arches because of smooth surface texture, the presence of saliva, and plenty of movable tissue and zones.[10] Therefore, the edentulous patient management for manufacturing complete dentures still relies on several steps, including the preliminary impression and acquisition of preliminary casts.[11-13]

Setting the denture foundation limits is important to obtain casts that faithfully reproduce all requirements for optimal fit to anatomical features, dimensional stability, and accurate impression.[14] Conventionally, the denture bearing area is marked by using a pencil that outlines the anatomical location.[11-15] The border may be designed 2 mm to 3 mm shorter than the intended denture foundation, checking the muscle insertions clearance to allow the final impression and to avoid overextension or adjustments in the custom trays.[16,17] The same principles should be applied to a digital technique to avoid unfavorable denture bearing areas that jeopardize the prognosis of the prosthetic treatment.

Previous studies have investigated the accuracy regarding the influence of scanning strategies and conventional impression techniques,[18] determination and recording maxillomandibular relationship,[19] and surface adaptation of complete denture bases using digital and conventional manufacturing techniques.[20-22] Although an intraoral scanner is easy to handle for less experienced professionals, the major challenge for the intraoral scanner is to replicate the buccal sulcus and non-attached mucosa, so it is still recommended to obtain preliminary impressions of edentulous jaws. Deng *et al*.[23] assessed the accuracy of a novel 3D-printed custom tray for impression and the findings showed that the 3D surface morphology of the impressions performed using diagnostic dentures was similar to the reference (definitive impression) than conventional impression, allowing the applicability of the digital technology in a clinical context. Yoshidome *et al*.[22] evaluated the trueness and fitting accuracy of denture bases considering digital and conventional methods and the results evidenced that milled bases had higher accuracy compared with 3D-printed and conventional denture bases. Even so, factors such as support structures and built pitch may jeopardize or modify the fitting accuracy.

Digital technology may provide innovative ideas for the manufacturing of complete dentures. If the denture foundation outlines carried out digitally are reproducible, the denture design may be simplified considerably, and the time-efficiency can be improved. It is fundamental to obtain a proper denture bearing outline because the denture base extension is closely associated with comfort and retention.[24] To our knowledge, there are no previous reports on the assessment of denture bearing area accuracy comparing digitized edentulous casts with the conventional method. Therefore, the purpose of this study was to evaluate the accuracy and working time to design the denture bearing area extension outline on edentulous casts when digital or conventional techniques are used. The study hypotheses were that (1) the accuracy of the digital method and conventional technique would be different and that (2) the digital method would require a shorter working time than the conventional technique.

MATERIALS AND METHODS

Institutional Ethics Committee Approval was received for this diagnostic study (Protocol number: 3.616.284). The research was performed following the STARD 2015 guidelines (Standards for Reporting for Diagnostic Accuracy Studies).[25] Inclusion criteria were defined as preliminary casts of bimaxillary completely edentulous patients with maxillary ridges classified as Class 1 or 2 in the Prosthodontic Diagnostic Index (PDI) for Complete Edentulism, and mandibular ridges classified as Class 2 or 3.[26] The exclusion criteria were preliminary casts with wax relief, presence of previous extension outline, and blebs or voids that hinder the accurate design of the denture bearing area. Informed consent was obtained from all participants before starting the research. The 28 preliminary casts [maxillary (n = 14); mandibular (n = 14)] included samples of edentulous patients who sought treatment for replacement of the complete dentures in the Department of Dentistry at Federal University of Rio Grande do Norte (UFRN).

The preliminary casts included were digitized using a laboratory scanner (Autoscan-DS-EX, Shining 3D Tech Co., Hangzhou, China) with no extension outline to verify the homogeneity in the ridge height (Table 1), following the methodology of Ryu *et al*.[27] The measurement points were set using the inspection software Geomagic Design X (3D Systems, Rock Hill, SC, USA). Posterior bilateral and anterior points were measured for maxillary and mandibular casts. The measurement points were a) Maxillary anterior height - distance between the highest point of the crest of ridge close to the incisive papilla and the lowest point of the gingivobuccal fold; b) Maxillary posterior height - distance between the highest point of the crest of the ridge close to tuberosity center and the lowest point of the gingivobuccal fold; c) Mandibular anterior height - distance between the highest point of the residual ridge on the midline/lingual frenulum and the lowest point of the gingivobuccal fold; d) Mandibular posterior height - distance between the highest point of the residual ridge close to posterior margin of the retromolar pad and the lowest point of the junction with the oral floor. For the posterior region, a mean value was obtained considering the measurements for the left and the right sides (Fig. 1). The period of edentulism was also evaluated to characterize the sample, as shown in Table 1.

The allocation sequence of the preliminary casts

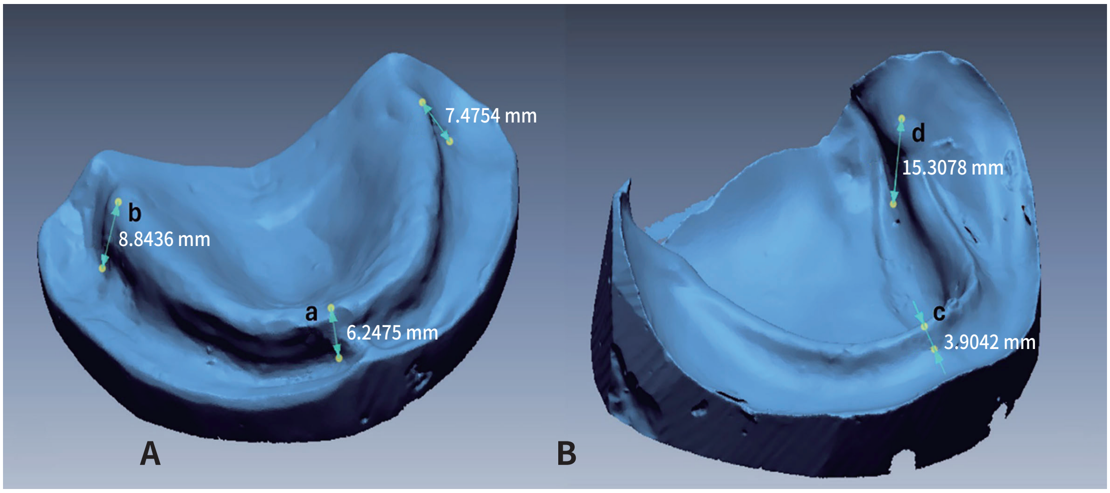

Fig. 1. Measurement for ridge height. (A) Measurement for maxillary ridge height (a: Anterior region; b: Posterior region). (B) Measurement for mandibular ridge height (c: Anterior region; d: Posterior region).

Table 1. Confounding variables that characterize the study sample

	Digital group		Conventional group		Total		
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	P^1
Maxillary anterior height (mm)	7	6.18 (1.54)	7	7.22 (2.71)	14	6.70 (2.19)	0.392
Maxillary posterior height (mm)	7	9.08 (2.62)	7	9.57 (2.46)	14	9.32 (2.46)	0.727
Mandibular anterior height (mm)	7	2.84 (1.31)	7	2.18 (1.13)	14	2.51 (1.22)	0.333
Mandibular posterior height (mm)	7	18.13 (4.80)	7	17.28 (4.27)	14	17.70 (4.38)	0.731
Maxillary edentulism time (years)	7	42.28 (8.19)	7	27.57 (16.71)	14	34.92 (14.77)	0.067
Mandibular edentulism time (years)	7	42.00 (8.32)	7	25.71 (16.70)	14	33.85 (15.23)	0.061

P^1: Independent samples t-Test.

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was generated by a single independent examiner (A.K.C.R.) based on even and odd numbers ranging from 1 to 14. The split was performed to determine the early sequence of the denture bearing area outline for conventional and digital methods. Based on the sort order, the even group represented the digital method group (DM), and the odd group represented the conventional method group (CM). A crossover design was applied to minimize possible study biases and avoid intra-individual variability. Therefore, both groups DM and CM were divided into subgroups, and the denture bearing area extension outline was performed after 7 days (washout period) to eliminate the residual effect of the denture bearing area outline (Fig. 2).

All steps of the denture foundation were carried out by a single expert examiner with 25 years of experience (S.L.D.M.). The denture bearing foundation extension outline was recorded repeatedly on digital and conventional casts for verification of the reliability of the marked lines and the kappa index was obtained to verify the intra-examiner agreement.[28] For this purpose, the denture bearing area outline was conducted in 20% of the total sample size. Before the beginning of the study, 6 mandibular and maxillary preliminary casts were randomly selected to verify the reliability of the method. The denture bearing area extension outline was carried out with both methods. In the conventional technique, the preliminary casts with extension outlines were digitized to obtain the STL_a files. In the digital technique, STL_b files of the digital casts with extension outlines were obtained. So, after 7 days, the outline was performed in the same preliminary casts, and the new STL_c (conventional method) and STL_d (digital method) files were obtained. The files (STL_a and STL_c) of the conventional method were superimposed (GOM Inspect; GOM GmbH, Braunschweig, Germany) to analyze

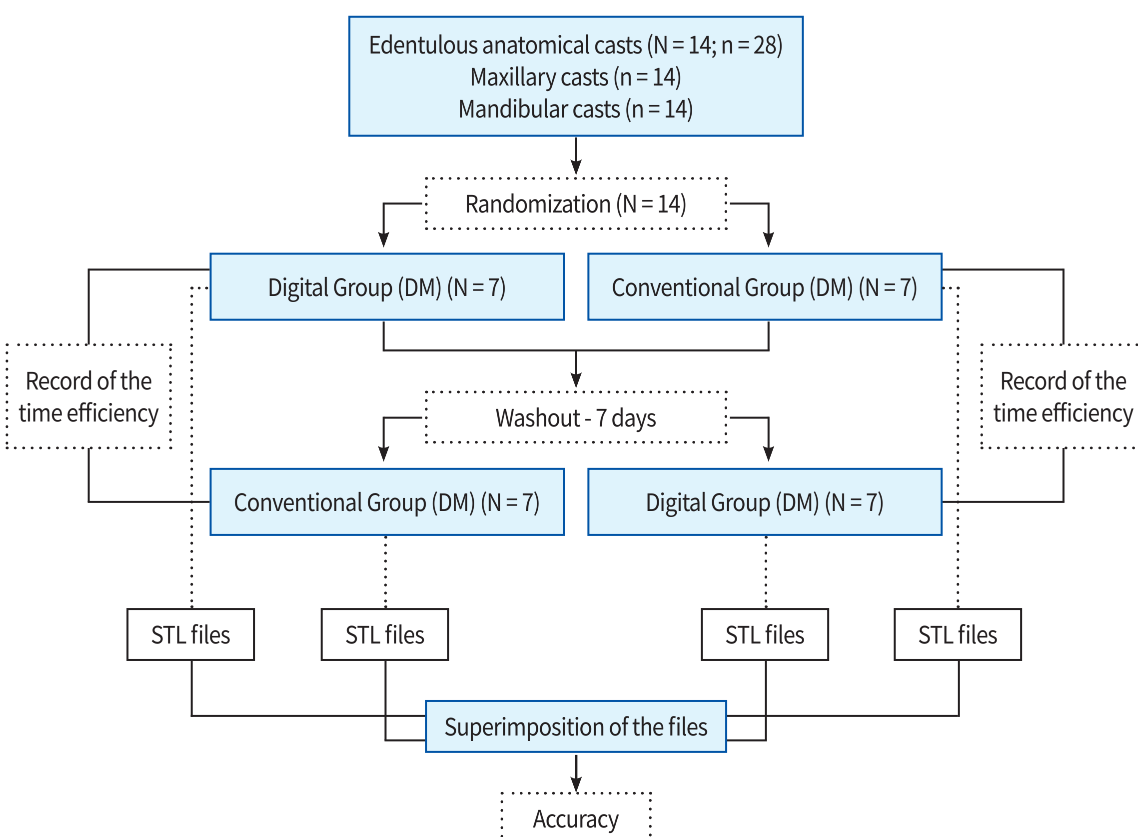

Fig. 2. Flowchart with the study protocol.
STL, standard tessellation language.

the intra-rater agreement of the measurements. The same protocol was carried out for the digital method (STL_b and STL_d).

The criteria for agreement level were based on the questionnaire considering the areas described below. The evaluation was composed of three questions for the maxillary casts and four questions for mandibular casts with dichotomous answering "agreement" or "no agreement". The agreement between conventional and digital methods for the design of the maxillary denture foundation extension outline was assessed: Q1 - hamular notch to buccal frenulum; (Q2) buccal frenulum to labial frenulum; (Q3) hamular notch to posterior palatine seal. For the design of the mandibular denture bearing area extension outline, it was verified if there was agreement between both methods: (Q4) retromolar pad to buccal frenulum; (Q5) buccal frenulum to labial frenulum; (Q6) retromolar pad to mylohyoid ridge; (Q7) mylohyoid ridge to lingual frenulum (Fig. 3).

For the conventional method, the extension was outlined on preliminary casts with a copy pencil (Faber Castell, São Carlos, SP, Brazil) and digitized. While scanners can digitize most objects without a hitch, some situations are a challenge, such as the extension outlined by pencil and the reflectivity of the objects. One way to overcome this struggle and assist 3D scanning is a superimposition on the designed lines with flexible wax (Cerafix, São Paulo, SP, Brazil) and the application of non-aqueous matt white spray coating (Metal-Chek D70, Bragança Paulista, SP, Brazil). The preliminary casts with denture bearing area extensions outlined were digitized (Autoscan-DS-EX, Shining 3D Tech Co.), and Standard Tesselation Language (STL_1) files were obtained. The graphic abstract with all steps of the study is described in Fig. 4. The boundaries were marked on preliminary casts following the sequence described in Fig. 3.

For the digital method, edentulous maxillary and mandibular casts were previously digitized with a laboratory scanner (Autoscan-DS-EX, Shining 3D Tech Co.) with no extension outline, and the extension outlining was performed by using software (DWOS, Straumann, Montreal, Canada). Scan files of the casts with no extension outline (STL_2) (Fig. 4C) were imported for the software (DWOS, Straumann, Montreal, Canada) and partial design tools were used. The denture foundation extension outline was performed using "clasp option" tools. So, the STL_3 file was obtained (Fig. 4D). The STL_2 and STL_3 were appended and combined using the open access code software program (Meshmixer; Autodesk Inc., San Francisco, CA, USA). Then, the STL_4 was obtained (Fig. 4E).

Extension outline deviations between convention-

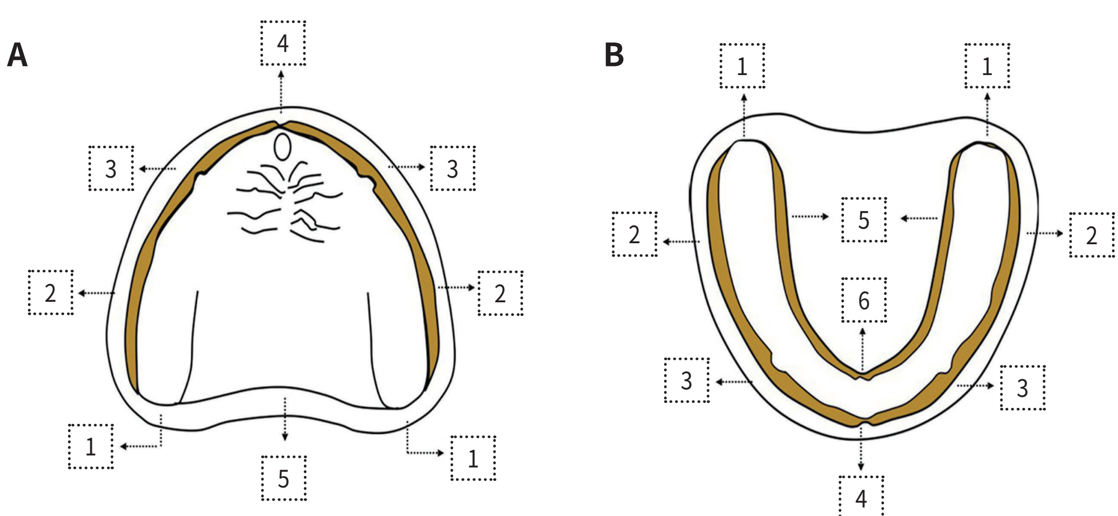

Fig. 3. Extension outline. (A) Edentulous maxillary cast (1: Hamular notch; 2: Buccal vestibule; 3: Buccal frenulum; 4: Labial frenulum; 5: Posterior palatal seal area). (B) Edentulous mandibular cast (1: Retromolar pad; 2: Buccal shelf; 3: Buccal frenulum; 4: Labial frenulum; 5: Retromylohyoid area; 6: Lingual frenulum).

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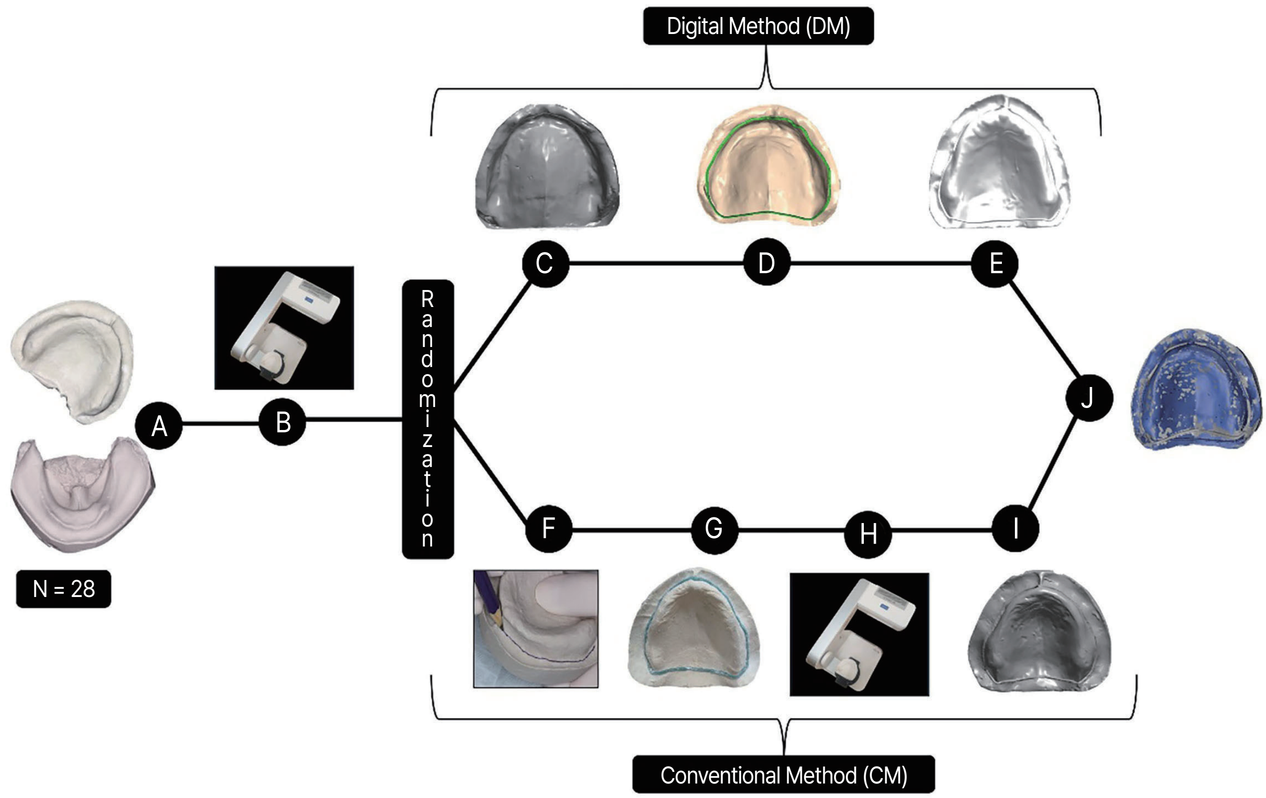

Fig. 4. Summarized steps of the study of conventional and digital methods. (A) 28 preliminary casts [maxillary (n = 14); mandibular (n = 14)] included representing a sample of 14 edentulous patients. (B) Edentulous preliminary casts digitized using a laboratory scanner (Autoscan-DS-EX, Shining 3D Tech Co, Hangzhou, China) with no extension outline. (C) Edentulous maxillary casts previously digitized with no extension outline. (D) Denture foundation extension outline in the preliminary cast using Dental Wings (DWOS, Straumann). (E) File digitized with extension outline in the digital group (STL_4). (F) Denture bearing area extension outline in a preliminary cast using a copy pencil. (G) Preliminary casts completely outlined and wax pattern superimposition (Cerafix, São Paulo, SP, Brazil) on the designed lines. (H) Digitizing of the preliminary casts with denture-bearing area extensions outlined (Autoscan-DS-EX, Shining 3D Tech Co). (I) File digitized with extension outline in the digital group (STL_1). (J) Extension outline deviations were qualitatively evaluated by superimposing by STL_1 and STL_4 files using software (GOM Inspect; GOM GmbH, Braunschweig, Germany).

al and digital techniques were qualitatively evaluated by superimposing the STL_1 and STL_4 files using software (GOM Inspect; GOM GmbH, Braunschweig, Germany). The STL files were assessed considering both sides in following regions: Maxillary casts - (a) hamular notch to buccal frenulum, (b) buccal frenulum to labial frenulum, (c) hamular notch to posterior palatine seal area; Mandibular casts - (a) retromolar pad to buccal frenulum, (b) buccal frenulum to labial frenulum, (c) retromolar pad to retromylohyoid area, (d) retromylohyoid area to lingual frenulum (Fig. 3). Regarding the settings of the software, the conventional method was defined as mesh and considered as the "reference" (gray color), while the digital method was defined as body CAD, which had the comparative effect (blue color).

The sensitivity, specificity, and accuracy were calculated in the present study.[29,30] The sensitivity was estimated from the proportion of true positives for both methods from the standard (conventional method). The specificity was expressed as a percentage of the true negatives for both methods when compared with the reference (conventional method). The accuracy of the test was evaluated as the ability to differentiate true positives and negatives in total sample size.[31] Mathematically, it may be stated as:

$$\text{Sensitivity} = \frac{TP}{TP + FN}$$

$$\text{Specificity} = \frac{TN}{TN + FP}$$

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

in which,

- True positives (TP): the number of agreements between both methods.
- False negative (FN): the number of agreements of the reference (conventional method) and no agreement with the digital method.
- True negatives (TN): the number of no agreements between both methods.
- False positives (FP): the number of no agreements of the reference (conventional method) and agreements with the digital method.

The comparability of the methods was tested, and the accuracy may be interpreted as follows: excellent (0.9 - 1.0), very good (0.8 - 0.9), good (0.7 - 0.8), sufficient (0.6 - 0.7), bad (0.5 - 0.6), and test not useful (< 0.5).[29] The maxillary and mandibular denture bearing area size in both methods was also calculated by using the tools of the software (GOM Inspect; GOM GmbH, Braunschweig, Germany).

The post-hoc power analysis was calculated on the G*Power software (version 3.1.9.7, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). Statistical analyses were performed using SPSS software v20.0 (IBM, SPSS Inc., Chicago, IL, USA). Mean and standard deviations were compared with both conventional and digital methods regarding time efficiency, considering a 95% confidence interval (CI) and 80% power for 14 participants. The Shapiro-Wilk test was applied to check the normality of the continuous variables. Because of the normal distribution of the data, parametric tests were used. A paired samples t-test was used for the comparisons of the denture bearing area extension outline for the digital and conventional methods regarding the measurement of the area size and time efficiency. The homogeneity of the groups was validated using the independent samples t-test. The accuracy, sensitivity, and specificity were evaluated mathematically, and the estimates of these characteristics were given.

RESULTS

For 28 preliminary casts analyzed comparing conventional and digital techniques regarding time efficiency, the sample power was 99.99%. Table 1 shows the homogeneity of the groups enrolled in the study regarding the residual ridge height and edentulism period ($P > .05$). The agreement test[28] for verification of the reliability of the marked lines generated a kappa of 0.81, which indicated almost perfect agreement. Table 2 shows the outlines of the maxillary and mandibular denture foundation area evaluated and the agreement level. The highest agreements were observed from the hamular notch to the buccal frenulum in the maxilla (92.9%) and from the mylohyoid

Table 2. Qualitative analysis of the denture foundation outline between digital and conventional methods

		Agreement n (%)	No agreement n (%)
Maxilla	hamular notch - buccal frenulum	13 (92.9%)	1 (7.1%)
	buccal frenulum - labial frenulum	8 (57.1%)	6 (42.9%)
	hamular notch - posterior palatine seal area	6 (42.9%)	8 (57.1%)
Mandible	retromolar pad - buccal frenulum	9 (64.3%)	5 (35.7%)
	buccal frenulum - labial frenulum	11 (78.6%)	3 (21.4%)
	retromolar pad - mylohyoid ridge	10 (71.4%)	4 (28.6%)
	mylohyoid ridge - lingual frenulum	12 (85.7%)	2 (14.3%)

ridge to the lingual frenulumin the mandible (85.7%).

For assessed outlines, the most accurate values between the digital and conventional methods ranged from good to excellent (0.71 - 0.92). Only the buccal frenulum to the labial frenulum region in the maxilla (0.57) and from the retromolar pad to the buccal frenulum in the mandible (0.64) demonstrated lower scores for accuracy (Table 3). The mean of denture bearing area extension outline was higher in the digital method, but no significant difference was found for the mandibular region (P = .112) (Table 4). The results showed shorter working time and better time efficiency for the conventional technique (P < .001) (Table 5).

DISCUSSION

The first study hypothesis was partially accepted as differences were found regarding the accuracy between the digital and conventional methods for all regions except for the maxillary anterior region. The second study hypothesis was rejected because the digital method required a longer working time for denture bearing area extension outlines. The advancements in digital dentistry have allowed the increase of automatization and cost-effective production of some steps of removable complete denture fabrication.[4] New production methods and treatment concepts have been expected; therefore, dental tech-

Table 3. Sensitivity and specificity tests, and accuracy between digital and conventional methods regarding the outlines

		Sensitivity	Specificity	Accuracy
Maxilla	hamular notch - buccal frenulum	0.92	NR*	0.92
	buccal frenulum - labial frenulum	0.85	0.28	0.57
	hamular notch - posterior palatine seal area	1.00	0.00	0.85
Mandible	retromolar pad - buccal frenulum	0.77	0.40	0.64
	buccal frenulum - labial frenulum	0.77	0.80	0.78
	retromolar pad - mylohyoid ridge	1.00	0.20	0.71
	mylohyoid ridge - lingual frenulum	0.90	0.75	0.85

NR*: No result was reported because the estimate for the specificity produced zero scores to TN (true negative) and FP (false positive); in other words, answers [no agreement] in the reference was not found.

Table 4. Mean (± SD) (mm^2) of the total maxilla and mandibular denture foundation between the methods

	N	Conventional method Mean ± SD	Digital method Mean ± SD	95% CI	Difference Mean ± SD	P*
Maxilla	14	3650.40 ± 619.48	3972.62 ± 645.88	251.52 - 392.91	322.22 ± 122.44	< .001
Mandible	14	3237.72 ± 332.25	3383.58 ± 372.54	39.16 - 330.88	145.86 ± 320.45	.112

* Paired t-test. CI: 95% confidence interval.

Table 5. Mean (± SD) (seconds) of the time for maxilla and mandibular denture foundation extension outline between the methods

	N	Conventional method Mean ± SD	Digital method Mean ± SD	95% CI	P*
Maxilla	14	45.12 ± 12.95	485.10 ± 219.78	316.27 - 563.66	< .001
Mandible	14	58.97 ± 16.05	485.44 ± 184.63	320.40 - 532.54	< .001

*Paired t-test. CI: 95% confidence interval.

nicians and dentists should put efforts into testing the handling and applicability of digital techniques by comparing them with the conventional method with well-established skills and abilities. Understanding whether the digital technique is feasible, reliable, and accurate when compared with the conventional method will provide answers regarding the future potential of this technology in the prosthodontic field.

Clinical and laboratory professionals should be acquainted with the anatomical features of edentulous ridges and recognize the landmarks registered from the preliminary impression.[15] The denture bearing area extension outline must include functional sulcus depth and width, with marked lines following border extension.[13] The results of this study showed that worse accuracy was obtained for the maxillary anterior region, from the buccal frenulum to the labial frenulum. This zone includes several muscles such as buccinator, orbicularis oris, and levator angulioris, which together create a knot defined as “modiolus”.[17] The higher presence of the muscle insertions and the requirement to contour the labial frenulum overhang are challenges, when maxillary denture foundation was outlined, justifying the inaccuracy of the digital method for this region. In this study, sufficient accuracy was found for the mandibular posterior area, specifically from the retromolar pad to the buccal frenulum. The retromolar pad is important for the support and the peripheral seal.[17] However, the residual ridge is generally resorbed in this area and the surroundings of the buccal frenulum, hindering the precision of the outline. Although the buccal frenulum is a tendon attachment of the buccinator muscle, the outlining of denture bearing area extension becomes more difficult because this anatomical landmark is not commonly seen on edentulous ridges.

Digital technology has promoted a decrease in the number of clinical appointments and laboratory input.[6] Although promising, procedures for conventional preliminary impressions such as pouring and obtaining preliminary casts are still in use. Previous studies have stated that overall cost and clinical chairside time were lower for fabricating complete dentures following digital protocols.[7-9] In this diagnostic study, the maxillary and mandibular denture foundation extension outline required longer working time, suggesting that performance with the digital process and proper handling of the software rely on the learning curve.

Preliminary casts provide information about the anatomy of the oral tissues and residual ridge and, thus, should be suitable for manufacturing the custom trays used for a definitive impression. Custom trays ought to be fabricated with an optimal boundary to anatomical landmarks supporting the accuracy of impression procedures, and this may be only attained on the proper design of the denture bearing area extension outline.[11] Recording of anatomical landmarks boundaries in edentulous casts is important in several aspects including the health of the tissues, comfort, function, and retention of the future dentures.[32] So, the outlining of extensions of denture foundation on preliminary casts should be appropriately extended covering all the available anatomy, including the functional sulcus depth and width, ensuring stability and avoiding dislodgement during function.[13]

The preliminary impressions should allow the manufacturing of casts in which the clinical professional will identify a peripheral extension with sufficient seal when seating the denture on soft and hard tissues.[11] The unfavorable denture-bearing area recording and outline drawn may be associated with overextension or under-extension, resulting in lack of retention and stability of removable dental prostheses, because the denture borders may interfere with the muscle movements during swallowing, mastication, and phonetics and may entail discomfort to the patient. The outcomes of this study revealed that the digital technique was accurate for denture bearing area extension outline even though time efficiency was lower.

The manufacturing of the preliminary casts has clinical significance based on two goals. The basic function is providing outline support, and the secondary function is acquiring a custom tray used to carry out the definitive impression.[33] Denture bearing extension area outline is performed in the preliminary casts of both conventional and digital techniques. Then, the custom tray is manufactured, and a definitive impression is made.[11] This approach is also considered for the digital workflow.[34] The digital workflow has increased rapidly in recent years by the advances in

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technologies, but conventional preliminary impressions and casts are still required. Using intraoral scanning to capture variable anatomy and viscoelastic soft tissues of edentulous jaws with movable mucosa is a challenging procedure.[35,36] Despite the development of intraoral scan technologies, these devices are still unable to record the position and morphology of mobile zones (oral buccal zone) in a functional state. Thus, conventional preliminary casts are needed to ensure the reproducibility of the sulcus and anatomical landmarks.

Learning the boundary to anatomical landmarks in edentulous preliminary casts is important in understanding the maximum extension of the edentulous mouth that may be covered by the complete denture.[24] However, this study had limitations that included a small sample size, so the diagnostic criteria mixed between several classes was unfeasible. Further studies with a larger sample size can be conducted to get more details about the relationship between the residual ridge and denture bearing minimum and maximum area extension outlined. Based on this analysis, it will be possible to evaluate if there is a range of area extensions able to provide dentures with tolerance limits of the fibromucous tissues and, consequently, more comfort for the patients.

Another limitation included that the denture foundation was carried out by a single expert examiner. It would be interesting for future studies to evaluate the accuracy and time considering the perspective of dental technicians, clinical professionals, and undergraduate students and compare the skills/performance between the expert and non-expert professionals for the digital process. After the CAD-CAM system was introduced, the widespread use of digital technology has emerged in Dentistry. Even though the results have been encouraging, changing the habits and methods used for a long time is not easy. However, dealing with the changes and advancements required by the digital age is pivotal. On behalf of the transition period from conventional to digital technique, the handling of software by clinical and technical professionals still depends on a learning curve. So, training programs for digital workflows could be a viable option to explore and learn about software tools, providing the competencies required to deal with new technologies, and reducing the clinical and laboratory time, and the steps to be optimized.

CONCLUSION

Based on the findings of this diagnostic study, it can be concluded that the digital method for denture foundation extension outline showed a sufficiently excellent accuracy, except for the maxillary anterior region. The agreement level between both methods reached high enough percentages, mainly for the hamular notch to buccal frenulum in the maxilla, and mylohyoid ridge to lingual frenulum in the mandible. The digital technique had the worse time efficiency when compared with the conventional one.

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